

**DESIGN MEMORANDUM**

on

**GLOUCESTER HARBOR**

**MASSACHUSETTS**

**U. S. ARMY ENGINEER DIVISION, NEW ENGLAND  
CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS  
May 1964**

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD  
WALTHAM, MASS. 02154

ADDRESS REPLY TO:  
DIVISION ENGINEER

REFER TO FILE NO.

NEDED-R

27 May 1964

SUBJECT: Design Memorandum on Gloucester Harbor, Massachusetts

TO: Chief of Engineers  
ATTN: ENGCW-E  
Washington, D. C.

1. In accordance with EM 1110-2-1150, Engineering and Design, Definite Project Studies, dated 15 January 1962, there are inclosed four (4) copies of the Design Memorandum on the subject project. The work to be undertaken involves dredging operations with no special design or excavation problems. The Design Memorandum is approved in accordance with paragraph 6 (b) of the above-referenced authority.

2. Planning on this project is 90% complete. Project is scheduled to be advertised 2 June 1964 with bids received and contract award by 30 June 1964. Formal assurances for local cooperation are expected to be furnished prior to taking of bids.

1 Incl  
Design Memo (in quad)

OTTO J. ROHDE  
Colonel, Corps of Engineers  
Acting Division Engineer

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PERTINENT DATA

1. A summary of the physical features and costs of the existing project for Gloucester Harbor, Massachusetts, is as follows:

<u>Features</u>	<u>Present Estimate(1964)</u>
Completed project modifications	\$ 763,000 (1)
Uncompleted project modifications:	
Dredge 20' deep entrance channel extending north and south of the State Fish Pier, and 16' and 18' deep branch channels into Smith and Harbor Coves, respectively, with adjacent 15' and 16' deep anchorages.	<u>835,000</u>
Total Project Cost	\$1,598,000

(1) Includes \$25,000 cash contribution from local interests.

PROJECT AUTHORIZATION

2. Authorization. The uncompleted modification for the improvement of Gloucester Harbor, Massachusetts was authorized by the River

and Harbor Act of 23 October 1962. The project, as authorized, modified the existing project to provide for:

a. An entrance channel into the Inner Harbor, 300 feet wide and 20 feet deep, with a turning basin 600 feet wide;

b. An access channel, 200 to 250 feet wide and 20 feet deep, along the waterfront to the northwest of the Gloucester Fish Pier;

c. An access channel, 200 feet wide and 20 feet deep, along the waterfront southeast of the Gloucester Fish Pier;

d. An access channel, 650 to 300 feet wide and 16 feet deep extending into Smith Cove;

e. An access channel, varying from 500 to 100 feet wide and 18 feet deep, along the waterfront west of Harbor Cove and into Harbor Cove;

f. An anchorage of about 5 acres, 15 feet deep, east of the entrance to Harbor Cove;

g. An anchorage of about 10 acres, 16 feet deep, opposite the entrance to Smith Cove; and

h. Removal of the isolated rock shoal adjacent to the entrance channel south of Harbor Cove, to a depth of 24 feet;

all generally in accordance with the plan of the Division Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable.

3. The project modification was authorized subject to the requirements that, prior to construction, local interests agree to:

a. Provide without cost to the United States all lands, easements, and rights-of-way required for construction of the project, and for construction and maintenance of aids to navigation, upon the request of the Chief of Engineers;

b. Hold and save the United States free from damages due to the construction works;

c. Provide and maintain depths in berthing areas and local access channels commensurate with the depths provided in the related project areas;

and provided further that, if it is determined in detailed studies that spoil-disposal areas are needed, local interests agree to furnish, upon request of the Chief of Engineers, and without cost to the United States, any such areas required including such dikes, bulkheads, and embankments as may be necessary for the initial dredging and subsequent maintenance.

4. Projects for Gloucester Harbor were adopted by River and Harbor Acts of June 10, 1872, August 5, 1886 and June 3, 1896. These authorizations provided for the removal of boulders, the clearing of ledge and the construction of a breakwater over Dog Bar.

5. The existing project for Gloucester Harbor and Annisquam River, authorized by the River and Harbor Act of 1888 and modified by enactment through 1945, but exclusive of the project modification authorized in 1962, provides for the following improvements:

a. A rubblestone breakwater 2,250 feet long surmounted by a superstructure of dry walls of heavy split stone enclosing a core of rubblestone from Eastern Point over Dog Bar to Cat Ledge.

b. The removal of three ledges in the inner harbor, one to 12 feet and two to 15 feet in depth at mean low water, and five ledges in the outer harbor, four to 18 feet and one to 25 feet in depth at mean low water.

c. Removal to a depth of 15 feet below mean low water of ledges and boulders obstructing the approach to the wharves between Harbor Cove and Pews Wharf near the head of the inner harbor and dredging to 15 feet below mean low water of the channel leading past the wharves.

d. Dredging Harbor Cove to a depth of 10 feet at mean low water.

e. Dredging an 8-foot channel through the Annisquam River, and

f. Dredging a 17-acre anchorage, 8 feet deep in Annisquam River at the entrance to Lobster Cove.

6. The existing project, exclusive of the project modification authorized in 1962, was completed in November 1958 with the dredging of the 8-foot anchorage in Lobster Cove. The removal of all ledges and boulders in Gloucester Harbor between Harbor Cove and Pew Wharf and other obstructing rocks was completed in 1894; and the removal of pinnacle rock was completed in 1896. The breakwater, completed in 1905, was repaired in 1940 and is in good condition. The removal of all ledges to project depth was completed in 1916. The total costs in the completed modifications of the existing project have been about \$763,000, of which local interests, in compliance with the requirements as set forth in the authorizing document for the improvement of Lobster Cove, contributed \$25,000 in cash towards the first costs of construction. No other cash contribution by local interests has been required. All other requirements of local cooperation for the completed work authorized prior to 1962 have been met.

7. The improvement being considered in this design memorandum is that authorized by the River and Harbor Act of 23 October 1962, as described in paragraph 2 above. Advance planning only has been done on this uncompleted modification. The uncompleted modification is shown on the attached project plan. Requirements of local cooperation for this uncompleted modification are described in paragraph 3 above.

#### INVESTIGATIONS

8. Physical investigation carried out in support of the survey report contained in House Document No. 341, 87th Congress, 2d Session, were made in 1955, 1957, 1958 and 1959 and consisted of hydrographic, topographic and probing surveys.

9. Additional probings supplemented by boring and sounding surveys were accomplished in early 1964. Detailed probings were made on 40-foot spacings, and 20-foot spacings where refusal was encountered. A total of 22 core borings were made in the probed areas. Soundings were made over the entire project area.

#### LOCAL COOPERATION

10. The requirements of local cooperations, as required by the authorizing document, are stated in paragraph 3 above. Formal assurances that the requirements of local cooperation will be met have been requested from the Division of Waterways, Department of Public Works of the Commonwealth of Massachusetts. The City of Gloucester upon request of

the Division of Waterways is presently in the process of executing assurances required by the Commonwealth of Massachusetts. A resolution by the State Legislature that the recently appointed Board of Commissioners for the Massachusetts Department of Public Works be delegated authority to execute the required assurances for local cooperation is currently in the process of adoption. Action on the resolution is expected to be completed in May 1964. Formal assurances are expected to be executed at that time. The views and concurrence with the project plan by interested Federal, State and local agencies were obtained during the course of the survey study. The project plan has been reviewed with these interests during the preconstruction planning phase of the project, and are listed below:

Governor Endicott Peabody, State House, Boston, Mass.  
Mr. James Fitzgerald, Commissioner, Mass. Dept. of  
Public Works, 100 Nashua St., Boston, Mass.  
Mr. Francis W. Sargent, Associate Commissioner, Mass.  
Dept. of Public Works, 100 Nashua St., Boston, Mass.  
Mr. John Hannon, Chief Waterways Engineer, Mass. Dept.  
of Public Works, 100 Nashua St., Boston, Mass.  
Mr. Henry J. Lasley, City Engineer, City Hall,  
Gloucester, Mass.

11. Gloucester Harbor has a history of improvement by the City of Gloucester and the Commonwealth of Massachusetts. The Division of Waterways, Public Works Department, Commonwealth of Massachusetts has expended approximately \$2,000,000 for improvement of Gloucester Harbor, including construction of a State Pier and fish processing plant which are leased to local interests. Other improvements to the harbor and the dates of completion thereof are as follows:

a. In 1952, the dredging of 22,000 cubic yards of material from an area northeast of the State Fish Pier in Gloucester Harbor to provide a depth of 6 feet at mean low water.

b. In 1955, the dredging of a total of 104,500 cubic yards of material from the following areas to provide the depths indicated:

(1) Along the east side of the State Fish Pier, for a distance of 250 feet, to provide a depth of 15 feet at mean low water.

(2) Along the west side of the State Fish Pier, for a distance of 700 feet, to provide a depth of 21 feet at mean low water.

(3) Along the wharves on the west side of the Inner Harbor, for a distance of approximately 1,250 feet, to provide a depth of 20 feet at mean low water.

c. In 1956 and 1957 the dredging of a total of 65,000 cubic yards of material from the following areas to provide the depths indicated:

(1) The easterly side of Smith's Cove to provide a depth of 6 feet at mean low water.

(2) Harbor Cove to provide a depth of 18 feet at mean low water.

(3) The Inner Harbor, northeasterly of the State Fish Pier to provide a depth of 6 feet at mean low water.

d. In 1959, the dredging of an area north of Buoy N-18, on a line with Buoy No. 20 to tie-in to the dredged area at the Quincy Market Cold Storage and Warehouse Company Wharf. The dredging provides a depth of 22 feet at mean low water.

e. The City of Gloucester and the Commonwealth of Massachusetts have jointly expended an amount in excess of \$400,000 for dredging work since 1952.

#### LOCATION AND TRIBUTARY AREA

12. Gloucester Harbor is located at the southern extremity of Cape Ann about 25 miles northeast by water from Boston Harbor. It actually consists of an outer and inner harbor, as follows:

a. The outer harbor is a large rectangular body of water nearly 1,000 acres in area at the 18-foot contour and extending approximately 3,100 yards southwesterly across its mouth from Eastern Point to Norman's Woe, a rocky promontory on the opposite shore and about 3,700 yards inland to the mouth of the inner harbor. A breakwater extends approximately 2,250 feet northwesterly into the outer harbor from Eastern Point to Dog Bar. The outer harbor contains two coves and two minor harbors.



b. The inner harbor consists of an area of about 52 acres at the 18-foot contour and contains two coves, Harbor Cove and Smith Cove, and extends about 400 yards across its mouth in a northwesterly direction from Rocky Neck to Fort Point and about 1,500 yards inland to the head of navigation. Gloucester's ocean going commerce is conducted in the inner harbor.

13. Gloucester Harbor and its approaches have very broken ground and many unmarked rocks and ledges making careful navigation necessary especially in foggy weather. Tidal currents are negligible, setting in and out of the harbor with comparatively small velocities. The harbor is protected on the east and southeast by the southerly arm of Cape Ann, but is exposed to southerly storms. The mean range of tide is 8.7 feet and the spring range is 10.4 feet. The locality of Gloucester Harbor is shown on U.S. Coast and Geodetic Survey Charts 233, 243 and on the map accompanying the memorandum.

14. The area immediately tributary to Gloucester Harbor is the city of Gloucester located on Cape Ann in Essex County, Massachusetts. It is one of the largest fishing ports in the United States. The principal industries are fishing, fish imports from foreign countries, extensive boatyard and marine railway activity and manufacturing. In addition to the commercial activity in Gloucester, the entire Cape Ann area constitutes a well developed recreational area with many hotels and some excellent beaches. The normal population of 25,000 is greatly increased by an influx of summer residents. The locality is served by the eastern division of the Boston and Maine Railroad and by a network of improved roads and highways.

15. No bridges cross any portion of the waterway under consideration for improvement. A submarine cable to transmit electric energy at 4,160 volts extends across the Inner Harbor in a westerly direction from the State Fish Pier. This cable is owned and maintained by the Merrimack-Essex Electric Company.

16. Gloucester has approximately 75 piers and wharves, 90% of which are used in some connection with the fishing industry. Of these, 32 with a total frontage of about 6,600 feet, are considered commercially important by local interests. All are located within the Inner Harbor. Nine fish purchasing firms have a total daily freezing capacity of 537 tons and a total cold storage capacity of 15,800 tons. Facilities completed in 1961 provide an additional cold storage capacity of 8,250 tons and an additional daily freezing capacity of 35 tons, as well as a wharf with berthing area of 425 x 80 feet at a depth of 21 feet below m.l.w.. These harbor

facilities, in the interests of the fishing industry represent an investment of over \$2,000,000.

17. Of the 75 wharves in the harbor, 2 are owned by the city. The fish pier is owned by the Commonwealth of Massachusetts and leased to the city. The remaining 72 wharves are privately owned and are not available to the public. There are no railroad sidings available at any of the wharves and docks in Gloucester Harbor. The local network of streets and highways provides ready access, by truck, to all major road and highway systems serving the area.

#### PROJECT PLAN

18. The project plan includes the removal and disposal of various types of materials including mud, sand, gravel, till and some ledge rock from the project areas to the depths described in paragraph 2 and shown on the attached plan. Removal of ledge rock will require drilling and blasting and dredging by bucket dredge. In view of variations in the type of materials anticipated to be encountered, it is proposed to take bids on the basis of removal of ledge and other unclassified material. It is estimated that to provide clear project depths the work involves the removal and disposal at sea of 2,500 cubic yards of rock and 152,000 cubic yards of unclassified materials. An allowance of one foot of overdepth dredging is included in the estimated quantities and the required grade in areas of ledge rock is established as 1 foot below project grade. The volumes were computed on the basis of side slopes of 1 on 3 in unclassified material and 1 on 1 in ledge.

19. The present plan is the same as that recommended in House Document No. 341, 87th Congress, 2d Session and authorized by the River and Harbor Act of 1962. It is considered to be the most feasible and economical plan to provide for efficient use of the harbor by present and prospective traffic and will enhance the economic growth of the community.

#### DEPARTURES FROM PROJECT DOCUMENT PLAN

20. The present project plan is the same as that recommended in the authorizing document, and authorized by Congress. No changes in the document project plan are anticipated. Overdepth allowances are the same as those used in the authorizing document.

#### COST ESTIMATES

21. The estimate of project cost determined in the authorizing

document was based on random probings and hydrographic surveys made in 1955, 1957, 1958, and 1959 and indicated that the materials to be removed consisted of mud, hard clay, gravel, ledge rock and boulders. It was estimated that 147,800 cubic yards of ordinary material, 10,000 cubic yards of hard material and 8,000 cubic yards of rock would be required to be removed within the project limits. Quantities are in terms of in-place measurement and include an allowance of 1 foot of overdepth and side slopes of 1 on 1 in rock areas and 1 on 3 in unclassified materials. It was anticipated that removal of the rock would require drilling and blasting, and dredging of all materials would be by dipper dredge, with disposal of materials at sea. The current estimate of cost is based on detailed probing and boring surveys made in January-May 1964 and includes an allowance of 1 foot of overdepth to provide for inaccuracies in the dredging process. Required grade in rock areas is established as 1-foot below project grade. The cost is based on prices prevailing in May 1964.

22. Current Estimate of Costs (May 1964)

09 Contract - Channels

Rock Removal	
2,500 c.y. @ \$50/c.y.	\$125,000
Unclassified Materials	
152,000 c.y. @ \$3.50	<u>532,000</u>
	\$657,000
Contingencies	<u>63,000</u>

Total Contract \$720,000

30 Engineering and Design 50,000

31 Supervision and Administration 65,000

Total Project Construction Cost  
(C of E funds only) \$835,000

Aids to Navigation (Coast Guard) 6,000

Total Project Costs (Fed. Funds only) \$841,000

### 23. Comparison of Costs

	<u>Document Estimate</u> (Nov 1960)	<u>Latest Approved Estimate</u> (July 1963)	<u>Current Estimate</u> (May 1964)
Volumes: Channel			
Rock Removal	8,000 c.y.	8,000c.y.	2,500 c.y.
Hard Materials	10,000 c.y.	10,000c.y.)	
Ordinary Materials	147,800 c.y.	150,000c.y.)	152,000 c.y.
Total Volumes	165,800 c.y.	168,000c.y.	154,500 c.y.
Contracts: Channel			
Rock Removal	\$ 400,000	\$ 410,000	\$ 125,000
Hard Materials	200,000	204,000)	
Ordinary Materials	275,000	261,000)	532,000
Contingencies	<u>132,000</u>	<u>125,000</u>	<u>63,000</u>
Total Contracts	\$1,007,000	\$1,000,000	\$ 720,000
Engineering & Design	16,000	50,000	50,000
Supervision & Adm.	<u>77,000</u>	<u>80,000</u>	<u>65,000</u>
	\$1,100,000	\$1,130,000	\$835,000
Total Construction Cost (C of E)	\$1,100,000	\$1,130,000	\$ 835,000
Aids to Navigation (Coast Guard)	<u>6,000</u>	<u>6,000</u>	<u>6,000</u>
Total Project Cost (Federal)	\$1,106,000	\$1,136,000	\$841,000

24. The significant change in cost of the project plan from the latest approved estimate is based primarily on the change in quantities of the rock to be removed as determined from the detailed probing and boring survey made in April-May 1964. The total decrease of \$295,000 in project cost is accounted for as follows:

a. Volume of rock was reduced from 8,000 cubic yards to 2,500 cubic yards based on reclassification of materials resulting in a decrease in cost of \$285,000. This decrease is offset by an increase of \$67,000 in cost of dredging other materials in view of the hard nature of some of the materials to be dredged but not classified as rock.

b. Adjustment in contingencies and government costs based on present scope of project work accounts for the remaining reduction of \$77,000 in project cost.

#### SCHEDULE FOR DESIGN AND CONSTRUCTION

25. Preconstruction planning for the improvement is essentially complete. Field investigations to determine present bottom conditions have been completed. Plans and specifications are about 85% complete and are proposed to be issued on or about 2 June 1964. Work involves removal and disposal of all materials, ledge rock and unclassified materials, under a single continuing contract. Present schedule contemplates award of contract by 30 June 1964. It is anticipated that construction will be completed in 7 months.

26. Fund requirements for the above schedule is as follows:

Allotted to date	\$300,000
Fiscal Year 1965	<u>535,000</u>
Total Funds	\$835,000

#### OPERATION AND MAINTENANCE

27. Maintenance of the project is the responsibility of the United States and will consist of periodic dredging to restore project depths within the limits of the authorized Federal project modification. Maintenance costs are based on shoaling over various sections of the harbor determined from actual hydrographic surveys showing differences in depths over a period of 25 years. The average annual additional maintenance cost of \$13,700 is based on an average annual deposition of 7,000 cubic yards over the project area. Annual maintenance costs of the navigation aids have been estimated by the Coast Guard as \$600.

## BENEFITS

28. The benefits expected to accrue from construction of the improvement are the same as those evaluated in the authorizing document. The benefits were evaluated on the basis of present and prospective traffic in the harbor over the life of the project. Total annual benefits estimated at \$147,600 consist of:

Reduction in tidal delays expense	\$133,600
Refuge from storms	4,000
Elimination of navigation hazards	<u>10,000</u>
Total Benefits	\$147,600

29. Annual charges computed in the authorizing document were based on a 50-year project life at an interest rate of 2 5/8% of the Federal investment. Since the interest rate at the time of initial appropriation was fixed at 2 7/8%, the current annual charges are computed at an interest rate of 2 7/8% over a 50-year project life.

### Annual Charges

Investment	\$841,000
Project life	50 years
Interest rate	2 7/8%
Interest and amor- tization	31,900
Maintenance	<u>\$14,300*</u>
Total Annual Charges	\$46,200

\*Includes aids to navigation

30. A comparison of annual benefits of \$147,600 to the estimated annual charges of \$46,200 yields a current benefit-cost ratio of 3.2 to 1.

## RECOMMENDATIONS

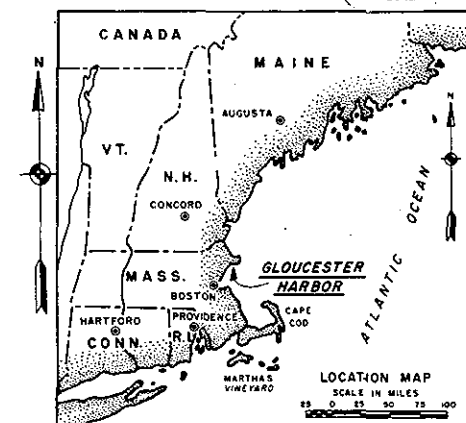
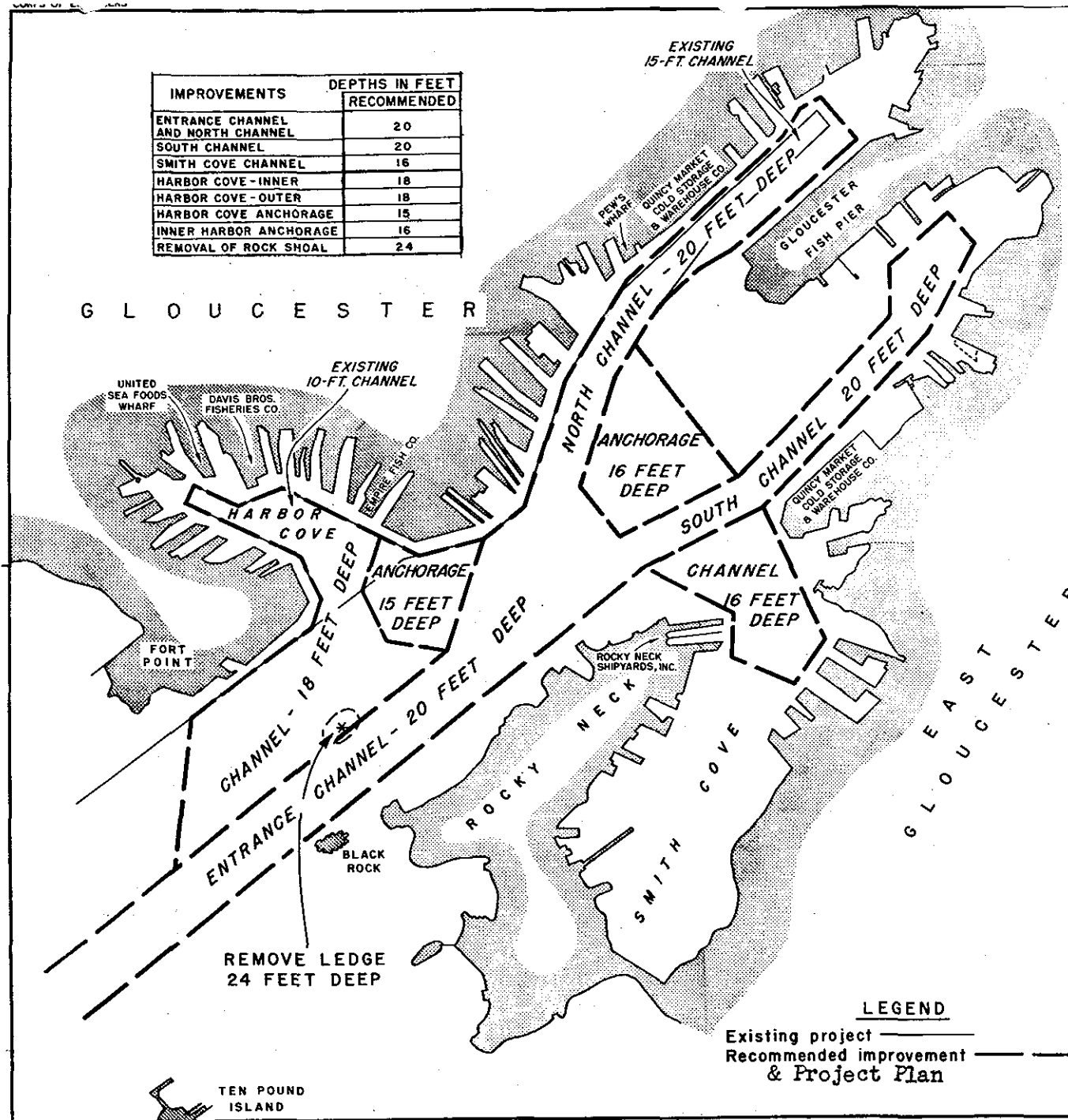
31. The plan of improvement proposed in this Design Memorandum provides for dredging a 20-foot deep entrance channel extending north and south of the State Fish Pier, and 16-and 18-foot deep branch channels into Smith and Harbor Coves, respectively, with adjacent 15-and 16-foot deep anchorages. The plan is the same as that described in House Document 341, 87th Congress, 2d Session, and authorized by the River and Harbor Act of 23 October 1962.

32. The project plan described in this Design Memorandum will serve adequately the present and prospective needs of the harbor and is justified economically. It is recommended that the authorized project be constructed as described herein.

Incl - Map (1)



IMPROVEMENTS	DEPTHS IN FEET
	RECOMMENDED
ENTRANCE CHANNEL AND NORTH CHANNEL	20
SOUTH CHANNEL	20
SMITH COVE CHANNEL	16
HARBOR COVE - INNER	18
HARBOR COVE - OUTER	18
HARBOR COVE ANCHORAGE	15
INNER HARBOR ANCHORAGE	16
REMOVAL OF ROCK SHOAL	24



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CORPS OF ENGINEERS, WALTHAM, MASS.

**GLOUCESTER HARBOR, MASS.**  
**INNER HARBOR**

100 0 200 400 600  
SCALE IN FEET

To Accompany  
Design Memorandum  
dated May 1964